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TRIP B-3

FEATURES OF UPPER SILURIAN AND LOWER DEVONIAN SEDIMENTARY ROCKS IN THE CAUCOMGOMOC LAKE AREA NORTHWESTERN MAINE

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INTRODUCTION

The purpose of this field trip is to examine the sedimentary structures and lithologic variability and to interpret depositional environments in two formations in the Caucomgomoc Lake area. The first of these has not been formally named or described and will be referred to informally as the Allagash Lake Formation[1]. This formation is of Late Silurian (Pridoli) and Lower Devonian (Gedinnian) age. The second formation is the Seboomook Formation of Lower Devonian (Siegenian) age. The sedimentary rocks of these two formations are distinctively different in terms of lithologies, sedimentary structures, and interpreted depositional environments.

AGE AND CORRELATION

Prior to work by Pollock (1983), no systematic mapping effort had been made in the Caucomgomoc Lake and Allagash Lake quadrangles. Reconnaissance in the 19th century was by Jackson (1838), and Hitchcock (1861). Hitchcock (1901), considered the volcanic rocks of the Pre-Silurian (figure 1) and Allagash Lake Formations to be "...'trappean and altered' rocks on Lakes Allequash (and) Cauquomogomoc...". He considered the sedimentary rocks of both the Allagash Lake and Seboomook Formations to the "Silurian and Cambrian Clay Slate." Keith (1933), followed essentially the same usage as established by Hitchcock. Doyle (1967), in his compilation of the area essentially showed correct distribution of the sedimentary rocks assigning a Lower Silurian (Upper Llandovey) to Lower Devonian (Siegenian) age for sedimentary rocks of the Allagash Lake Formation and an Ordovician to Silurian age for the volcanics. A Lower Devonian (Upper Gedinnian and Siegenian) was assigned for sedimentary rocks of the Seboomook Formation. Sprague (1972), partially mapped the Caucomgomoc Lake

[1]The name Allagash Lake Formation has been approved for use by the Geologic Names Committee of the U.S. Geological Survey. No attempt is made to formally describe this unit here. As used here, this name is strictly informal and its use is only intended to facilitate discussion. Formal naming and description will be done elsewhere. Informal usage is with permission of the Geologic Names Committee.

EXPLANATION

LOWER DEVONIAN

Dsu — SEBOOMOOK FORMATION UNDIFFERENTIATED

ORDOVICIAN(?) TO DEVONIAN(?)

ODf — FRONTENAC FORMATION

UPPER SILURIAN AND LOWER DEVONIAN

ALLAGASH LAKE FORMATION

DSav — predominantly pillowed baslat with interbedded conglomerate, limestone and sandstones of various classification

DSas — mixed sedimentary rocks including limestone, wackes, arenites, siltstones and shales (with and without hematite cement) and conglomerates.

CAMBRIAN(?) AND ORDOVICIAN(?)

UNIT 3 (Hurd Mountain Formation)

€Ohb — pillow basalts, basaltic agglomerate and basaltic lapilli tuffs

€Ohm, **€Ohs** — meta-siltstone, claystone slate and phyllite minor calcareous meta-siltstone. Commonly exhibits rusty weathering. Unit is complexly deformed and pervasively sheared. Unit is interpreted as a tectonic melange. Other rock types in the pelitic host include quartz wacke, meta-basalt, ultra-mafics, gabbros, diorites and granodiorites.

€Ohs — medium to thick bedded quartzose wacke, usually texturally uniform and lacking sedimentary structures.

UNIT 2 (Caucomgomoc Lake Formation)

€Ocb — a dominantly phyric and aphyric meta-basalt flows undifferentiated.

$€Ocb_2$ — upper member on Caucomgomoc Lake. Phyric and aphyric pillowed and non-pillowed basalt flows, basaltic agglomerate and basaltic lapilli tuff.

€Ocs — medium to thick bedded quartzose wacke and siltstone.

$€Ocb_1$ — lower member on Caucomgomoc Lake. Basaltic lapilli tuffs, basaltic agglomerates, basaltic flows common.

This unit is locally intruded by gabbroic and ultra-mafic stocks and dikes.

UNIT 1 (Loon Stream Formation)

€Ol — greenish meta-pelite including siltstone, slate and phyllite. Thin to thick bedded ubiquitous laminae and grayish red color common locally.

FIGURE 1 - Geologic sketch map of the Caucomgomoc Lake area.

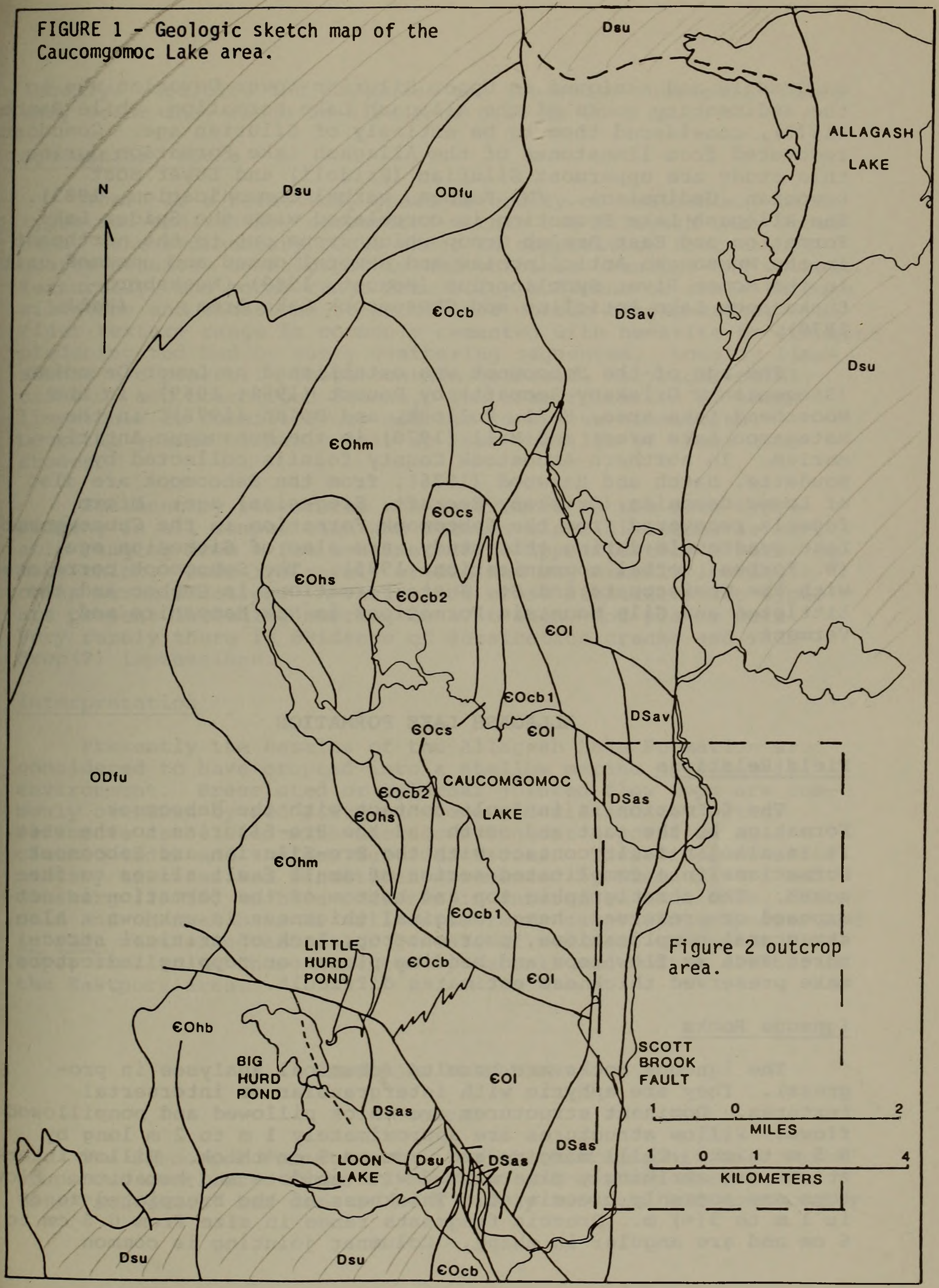

Figure 2 outcrop area.

quadrangle and assigned an Upper Silurian-Lower Devonian age to the sedimentary rocks of the Allagash Lake Formation, while Raabe (1973), considered them to be entirely of Silurian age. Conodonts recovered from limestones of the Allagash Lake Formation during this study are uppermost Silurian (Pridoli) and Lower most Devonian (Gedinnian). (W. Forbes, verbal communication, 1983). The Allagash Lake Formation is correlated with the Spider Lake Formation and East Branch Group which crops out to the northeast in the Munsungun Anticlinorium and several named and unnamed unite in the Moose River Synclinorium (Boucot, 1969), Weeksboro-Lunkunsoos Lake Anticline and Chesuncook Lake Area. (Hall, 1970).

The age of the Seboomook was established as Lower Devonian (Siegenian or Oriskany-Becraft) by Boucot (1961, 1969), in the Moosehead Lake area; Hall, Pollock, and Dolan (1976), in the Matagamon Lake area; and Hall (1970) in the Munsungun Anticlinorium. In northern Aroostook County fossils collected by Boudette, Hatch and Harwood (1976), from the Seboomook are also of Lower Devonian (Oriskany-Becraft, Siegenian) age. Micro fossils recovered from the Seboomook Formation in the Caucomgomoc Lake quadrangle during this study are also of Siegenian age. (W. Forbes, verbal communication, 1983). The Seboomook correlates with the Temiscouata and St. Juste Formations in Quebec and the Littleton and Gile Mountain Formations in New Hampshire and Vermont.

ALLAGASH LAKE FORMATION

Field Relations

The formation is in fault contact with the Seboomook Formation to the east and north and the Pre-Silurian to the west. It is also in fault contact with the Pre-Silurian and Seboomook Formations in a complicated series of small fault slices to the south. The stratigraphic top and bottom of the formation is not exposed or preserved, hence original thickness is unknown. Also, structural complications, poor outcrop, lack of critical structures such as flow tops and bedding planes or topping indicators, make preserved thickness estimates difficult.

Igneous Rocks

The igneous rocks are basalts (chemical analyses in progress). They are aphyric with intergranular or intersertal textures. Dominant structures are thick pillowed and nonpillowed flows. Pillow structures are approximately 1 m to 2 m long by 0.5 m thick. Chill margins are 2 cm to 5 cm thick. Pillow interstices are strikingly mineralized with epidote and hematite. Flow tops are commonly brecciated. Thickness of the brecciated zones is 1 m to 3(+) m. Breccia fragments range in size from 0.5 cm to 6 cm and are angular in shape. Columnar jointing is common

locally. Vesicles and amygdules are generally uncommon. Where they occur they range in size from 0.25 cm to 1 cm.

Sedimentary Rocks

There is a relatively great diversity of sedimentary rock types and sedimentary structures within the Allagash Lake Formation. The sedimentary rocks range in composition from mature quartz arenites to feldspathic and volcanic arenites and wackes. Texturally, the rocks range from silty mudstone or shale through siltstone and sandstone to pebble and cobble conglomerate. The finer texture range is commonly cemented with hematite or limonite producing red bed or rusty weathering sequences. Locally limestones are present. These contain ostracod, bryozoa, coral, crinoid, and brachiopod faunas. The classification of these limestones is fossiliferous micrite to sparse biomicrite. Detrital grains normally make up less than 15% of these limestones

Sedimentary structures are as diverse as the rock types. Bedding in all composition and texture classifications is variable ranging from a few centimeters to approximately a meter or more thick. Beds are rarely graded and may exhibit low angle cross stratification. A variety of cross stratification types are present including herring bone, trough, and planar sets. Very rarely there is evidence of dessication cracks and raindrop(?) impressions.

Interpretation

Presently the basalts of the Allagash Lake Formation are considered to have erupted into a shallow marine or subaerial environment. Brecciated or columnar jointed flow tops are commonly overlain by red silty mudstone and siltstones. Other sediments associated with the flows suggest deposition as a clastic tidal and shallow subtidal facies. These include sedimentary textures and structures documented by Klein (1977) and Ginsburg (1975), to have occurred in intertidal sand bars, channels and channel bars as well as features suggesting exposure and *in situ* weathering and color genesis of sediment on basalt flow tops, similar to those reported by Farrell and Norton (1978), in the Eastport area.

SEBOOMOOK FORMATION

General

The Seboomook Formation is a major stratigraphic unit which crops out over large areas of northern and western Maine. The term "Seboomook" has come to be a widely accepted and generically

applied name for monotonous, cyclically bedded slates and sandstones of Siegenian (Oriskany-Becraft) age within Maine. Perkins (1925, p. 374), first described the Seboomook as "...a dark blueish slate often with well developed cleavage..." and "...sandstone layers (with alternate layers of light and dark slate)...". Perkins derived the name Seboomook slate from Seboomook Dam. He did not establish a type section but rather referred to two localities; one for the "best exposures" of the sandstones at Seboomook Dam, and one for "typical slate" two miles south of the "Y" on the Rockwood-Seboomook Road. Boucot (1961), redefined the Seboomook slate as the Seboomook Formation with a type section "at the east end of Seboomook Lake...and on the Penobscot River for a mile downstream." Boucot's lithologic description (p. 170), of the Seboomook, is as follows:

> "The Seboomook Formation consists almost entirely of cylically layered dark sandstone and slate. The cyclic layering resembles varves and the sandstone layers grade upwards into the slate layers... The layers are fractions of an inch to several feet thick..."

Boucot (1969, p. 34), discussed the variety and proportions of slate and sandstone lithologies in the Moose River Synclinorium. Slate included greater than 95% in certain areas while sandstone at the type locality was more than 50% of the unit. Similarly, Hall (1970, p. 41), considers sandstone to be less than 50% of the formation. Boudette, Hatch and Harwood (1976), consider the Seboomook to consist of variable proportions of calcareous graywacke, gray slate and cyclically bedded gray slate. This usage was followed by Roy (1980). Boudette, Hatch and Harwood (1976), and Roy (1980), were able to subdivide the Seboomook into a lower graywacke and gray slate, or gray slate containing minor graywacke phase and an upper cyclically bedded gray slate and sandstone phase.

The stratigraphic base of the Seboomook varies locally. The stratigraphic top is not well established in the central and western outcrop areas. The total preserved thickness appears to increase to the west and north. The Seboomook is considered by Boucot (1961, 1969), to rest unconformably on granitic and gneissose basement in western Somerset and Franklin counties, and also on the Beckpond limestone and Silurian Hobbstown and Hardwood Mountain Formations in the Moose River Synclinorium. The Seboomook is also unconformable on Lower Paleozoic (Cambrian through Silurian), units in the Matagamon Lake area and Munsungun Anticlinorium. At the western margin of the Moose River Synclinorium Boucot (1961), considers the contact of the Seboomook with the underlying Frontenac Formation to be gradational. Pollock (1983), also suggests the possibility of a conformable contact of the Seboomook with the underlying Frontenac in the western portion of

the Caucomgomoc Lake and Allagash Lake quadrangles. In northwestern Aroostook County, Boudette, Hatch and Harwood (1976), and Roy (1980), show the Seboomook to be in contact with the Silurian "Five Mile Brook sequence" and Lower Devonian "Hafey Mountain sequence." Roy (1980, p. A-24), suggests a possible tectonic (shear zone) contact between the Seboomook and "Five Mile Brook sequence."

The upper contact of the Seboomook is gradational and conformable with the Matagamon sandstone (Pollock, 1972; Hall, Pollock and Dolan, 1976); in the Matagamon Lake area and with the Tarratine Formation (Boucot, 1961, 1969), in the Moose River Synclinorium. The stratigraphic top is not established in the central and western portions of the outcrop belt. Total thickness of the Seboomook varies. Neuman and Rankin (1966), estimate approximately 1,200 m in the Matagamon Lake area. Boucot (1961), estimates 3,000-6,000 m in the Moose River Synclinorium and Boudette, Hatch and Harwood (1976), estimate 5,000 m in northwestern Aroostook County. Overall there appears to be stratigraphic thickening westward.

The internal stratigraphy of the Seboomook is not well established. Overall there appears to be a sandier section near the base as reported by Hall (1970); Boudette, Hatch and Harwood (1976); and Roy (1980). Boucot (1969), established the Camera Hill greenstone member in the upper portion of the Seboomook and the Bear Pond limestone member of uncertain stratigraphic position There is a great deal of room for careful and detailed work in the subject area of Seboomook stratigraphy.

LITHOFACIES

Five lithofacies have been recognized in the Caucomgomoc Lake and Allagash Lake quadrangles. These lithofacies are similar to, or idential to lithofacies both mapped and unmapped for the Seboomook. Criteria used to differentiate the five lithofacies include gross rock type (i.e., slate, wacke, conglomerate) bedding characteristics and sedimentary structures. The five lithofacies include: 1) conglomerate; 2) medium to thick bedded (15 cm to 1 m) wackes with thin (less than 10 cm) claystone or siltstone slate interbeds; 3) thin (less than 10 cm) bedded wackes with thin (less than 10 cm) claystone slate interbeds; 4) thin bedded claystone slates with abundant laminae of silt or sand sized wacke; and 5) medium to thick bedded claystone slate with rare parallel laminae of silt sized material.

1. Conglomerate - Conglomerates form a minor but mappable lithology within the Seboomook Formation east of Caucomgomoc Lake. The conglomerate is lithogically similar to conglomerates of the Allagash Lake Formation. These consist of pebble to cobble sized clasts of angular to subrounded aphanitic

volcanics. The conglomerate is clast supported. Bedding is indistinct and crude grading is observed locally. Contacts of the conglomerate and the other lithofacies of the Seboomook are not exposed. These are interpreted as a submarine channel fill. Hall, Pollock and Dolan (1976); and Hall and Stanley (1972); recognize submarine channels in the Seboomook to the east in the Matagamon Lake area.

2. Medium to thick bedded wackes with thin claystone or siltstone slate interbeds - This lithofacies consists of poorly sorted fine to very fine grained quartzose and feldspathic wacke. Beds range from 15 cm to 2 m in thickness. The bases are sharp. Sole markings are rare. Claystone or siltstone beds are thin (less than 10 cm). Interpreted mechanism of deposition is by turbidity current. Bouma Sequences (Bouma, 1962), include only rare graded or massive intervals. Most commonly the sequences are "bc" and "bcd". The c interval consists of current ripple, rare climbing ripple and convolute laminae. Burrow structures in the "d" interval are uncommon. The turbidites commonly have repetitive bc sequences. These are interpreted as possible submarine fan or fan channel assemblages. Sequences of this lithofacies are not common.

3. Thin (less than 10 cm) bedded wackes with thin (less than 10 cm) bedded claystone slates - Wackes of this lithofacies consist of poorly sorted, very fine sand to coarse silt in chlorite and sericite matrix. Wacke beds average 6 cm in thickness; sole markings are very rare to absent. Sedimentary structures are most commonly the bc turbidite sequence. The c interval is ripple cross lamination. The claystone slate appears structureless, but may be texturally graded. Burrows are rare. Sand : slate ratio of this lithofacies is approximately 1 : 1. The wackes of this lithofacies are interpreted as "distal" turbidites relative to the wackes of the preceding lithofacies. Deposition of this lithofacies is interpreted to have occurred on the lower or distal portion of submarine fans. This lithofacies is moderately common.

4. Thin bedded claystone slate with abundant laminae of silt or sand sized wacke - The claystone slate beds commonly range from 1 cm to 10 cm in thickness. Textural gradation in these beds may be present. Burrows are rarely present. The laminae are commonly sharp and texturally grade upwards into the overlying claystone. Ripple lamination is common within these laminae. Average thickness of these laminae is 5 mm and they number from approximately 10 to 50 or more per meter. This lithofacies is interpreted to have been deposited as hemipelagic sediment and/or mud turbidites. Similar lithofacies and interpretation is recorded in the Seboomook by Hall and Stanley (1973). This lithofacies is very common in the southern and eastern portions of the area.

5. Medium to thick bedded claystone slate with rare parallel laminae of silt sized material - The claystone slate beds commonly range from 15 to 50 cm in thickness. Bedding planes are indistinct and where seen are delineated by very fine silt laminae. This lithofacies is characterized by "paper thin" cleavage. Parallel laminations of very fine grained silt are the only sedimentary structures seen. Deposition is interpreted to have been in the hemipelagic or pelagic environment. This lithofacies is most common in the western outcrop area.

DEPOSITIONAL ENVIRONMENT

Depositional environment of the Seboomook has been interpreted by Hall, Pollock and Dolan (1976), to have been a pro-delta marine slope association, where the Seboomook represents a classical shaly flysch. This interpretation is consistent with the interpretation of depositional mechanism and environments included with the lithofacies as discussed here. It is suggested that the basin margin and slope was to the east. Sediment transport was from east to west (Hall, Pollock and Dolan, 1976, p. 61; and Pollock, 1972), at the basin margin. In the portion of the basin discussed here, deposition was predominantly hemipelagic and pelagic with submarine fan deposits. Sediment transport in this outcrop area was parallel to the basin axis in a northerly direction (Pollock, unpublished).

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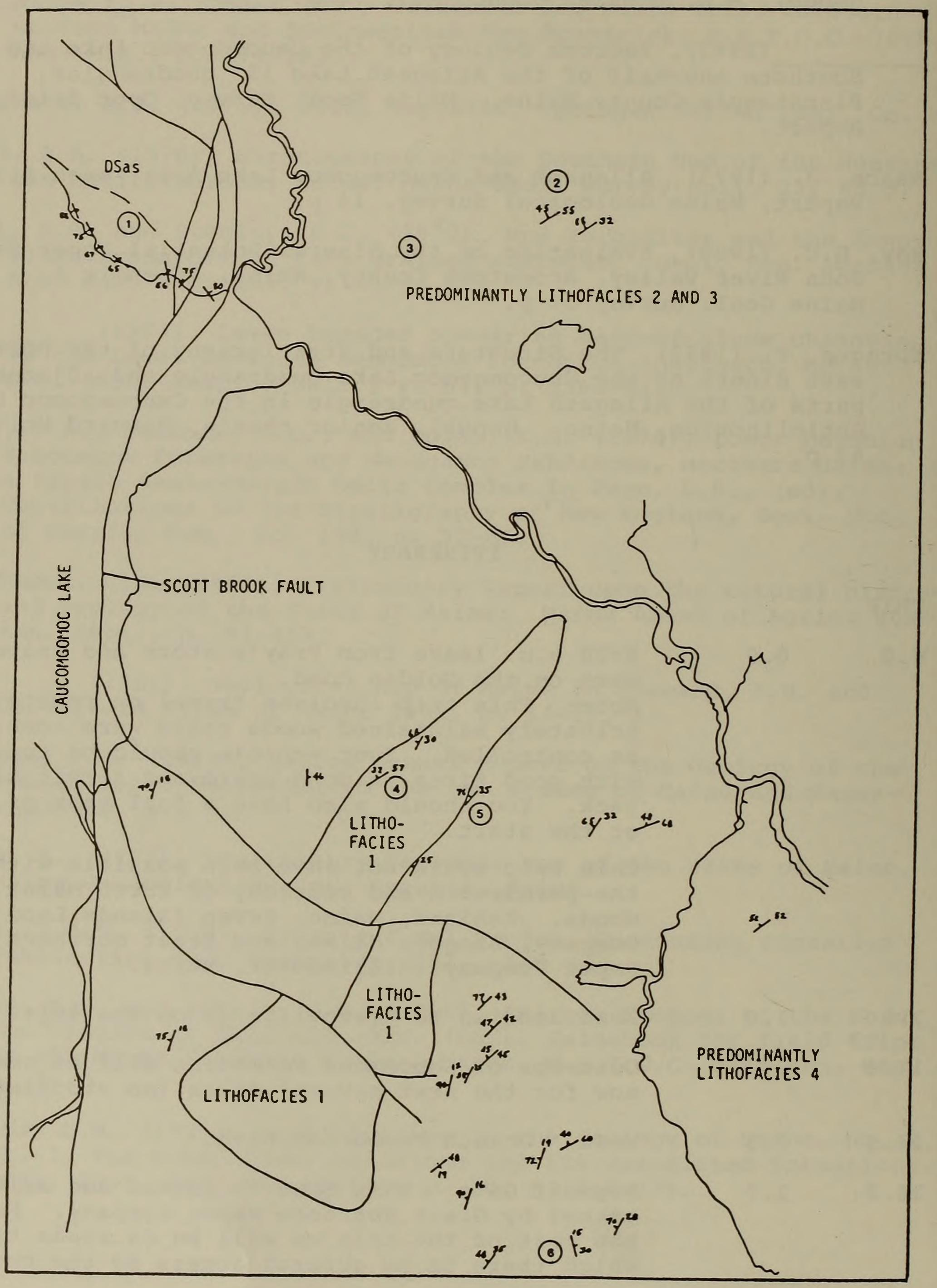
ITINERARY

TRIP		
0.0	0.0	8:00 a.m. leave from Pray's store and travel west on the Golden Road. Note: This trip involves travel on remote, privately maintained woods roads were access is controlled. Your vehicle should be equipped with good tires, a good spare and a reliable jack. You should also have a full tank of gas at the start. This trip would not have been possible without the permission and courtesy of North Maine Woods, Ashland, Maine; Seven Islands Land Company, Bangor, Maine; and Great Northern Paper Company, Millinocket, Maine.
7.8	7.8	Road leading to Greenville is on the left.
17.0	9.2	Outcrops of Seboomook Formation will be seen now for the next several miles (no stopping).
24.5	7.5	West branch Penobscot River
26.2	1.7	Ragmuff Gate. This gate is locked and maintained by Great Northern Paper Company. For the rest of the trip we will be on roads to which there is no general access by the public.


DSas
1
2
3
PREDOMINANTLY LITHOFACIES 2 AND 3
SCOTT BROOK FAULT
CAUCOMGOMOC LAKE
4
5
LITHO-
FACIES
1
LITHO-
FACIES
1
LITHOFACIES 1
PREDOMINANTLY
LITHOFACIES 4
6

Speeds on these roads will be between 25 and 45 mph. Do not deviate from the route described or lag behind.

The terrain for the next several miles is relatively flat. Outcrop is sparse. This is typical of terrain underlain by the Seboomook Formation.

32.8	6.6	Former site of Great Northern's Ragmuff logging camp.
40.6	7.8	Bear to left at Forestry sign.
40.9	0.3	Junction of Four Roads. Bear to right on the road which is maintained. (Not a sharp right onto the road with the grassy center leaving the gravel road on your left.)
41.2	0.3	Town line marker.
44.3	3.1	Locked gate. We are now leaving Great Northern lands. Lands that we are now driving on are managed by Seven Islands Land Co. Continuing down this road, ridges which appear before us are the outcrop area of the Allagash Lake Formation.
46.3	2.0	Caucomgomoc Lake Dam. From the dam you have a panoramic view of Caucomgomoc Lake. Low hills to the north (right, as you face Caucomgomoc Lake), are the outcrop area of Allagash Lake Formation. The hills in the distance to the west (looking down the lake), is the outcrop area of the Frontenac. The lower hills, also to the west and closer to the lake, are Pre-Silurian outcrop. The trace of the Scott Brook fault trends approximately north-south between the dam and the Allagash Lake Formation. Scott Brook, Loon Stream and Ciss Stream all follow this fault. The Scott Brook fault separates the Allagash Lake Formation from the Seboomook Formation. Cross the dam and proceed.
47.9	1.6	LEFT TURN
50.9	3.0	Ciss Stream Bridge. (As this itinerary goes to press, the bridge is badly in need of repair. Hopefully it will still be passable for the trip.)

51.2	0.3	Junction of logging road with small, unmaintained spur. The party should combine themselves now into the highest clearance vehicles. We will proceed down the small spur road approximately two miles to the shore of Caucomgomoc Lake. This road <u>should</u> be passable to two-wheel drive vehicles. There may be a few wet and muddy spots and care should be taken to navigate them correctly.
		STOP 1. Proceed to the shore of Caucomgomoc Lake and traverse westerly along the shore approximately 0.6 mi. This section, at times of low water, best illustrates the variability of sedimentary rock types and sedimentary structures in the Allagash Lake Formation. The rocks include redbeds, quartz arenites and limestones with diverse fauna. The section is overturned and small folds may be observed locally. The interpretation put forth is that these rocks were deposited in shallow water, perhaps shallow subtidal and tidal environments. Comments and criticisms would be greatly appreciated.
		Return to vehicles and retrace route to the "main" road. We will begin to retrace our route. The remainder of stops today will be in the Seboomook Formation.
51.5	0.3	Ciss Stream Bridge
51.5	0.6	This is a newly constructed and active "borrow pit". The Seboomook here is typically a hybrid between lithofacies 4 and lithofacies 5. The slate here is uniformly and ubiquitously laminated with silt sized material.
53.8	2.3	Logging camp. Continue straight.
54.6	0.8	STOP 2. Outcrops are on either side of the left hand spur road. The best outcrop is to your left as you proceed down the road. The section here is representative of lithofacies 3. The Seboomook consists of thin bedded ripple cross-laminated wacke with thin interbeds of claystone or siltstone slate.
		Return to vehicles and retrace route.
55.4	0.8	LEFT TURN

55.8	0.4	STOP 3. (Optional) Outcrop is a pavement in a logged over yard on the right. The section consists of lithofacies 3, and is very similar to STOP 2.
57.0	1.2	Caucomgomoc Dam
59.5	2.0	Great Northern Paper Company gate.
59.8	0.3	LEFT TURN
60.3	0.5	STOP 4. Conglomerate lithofacies. In this immediate area are several small knolls of pebble conglomerate. The clasts are commonly felsic to intermediate aphanitic volcanics. Shades of gray are the most common color of the clasts, but red and green coloration may be seen. The clasts are for the most part rounded and textural gradation may be seen in some beds. Bedding is commonly thick and bedding planes are indistinct. Trough cross beds are locally present, the major structure is the regional cleavage and small en echelon quartz veins. Proceed.
60.8	0.5	LEFT TURN and proceed without turning.
61.9	0.7 to 1.1	STOP 5. This stop illustrates the nature of sedimentary slumping that is locally present in the Seboomook. Outcrops are present at the intersection of two roads and down the left hand spur road. Retrace route to the Caucomgomoc Dam road.
63.6	1.7	LEFT TURN
66.8	3.2	LEFT TURN. Proceed down road with grass growing in the center strip. (Road to Black Pond)
67.4	0.6	Town line post on right.
67.5	0.1	LEFT TURN
68.0	0.5	RIGHT TURN
68.5	0.3 to 0.5	STOP 6. There are several small outcrops to the north (left). This is the thin bedded claystone slate with abundant laminae of silt or sand sized wacke lithofacies.

		This is the most common lithofacies of the Seboomook in the area. The outcrops here are typical of size and extent of this particular lithofacies. You may observe bedding, determine stratigraphic tops, observe refracted and kinked cleavages, and see local minor folds here. Retrace route for approximately 1.3 miles.
69.8	1.3	LEFT TURN
70.1	0.3	Junction of four(4) roads. Continue straight.
71.3	1.2	Intersection with Loon Lake Road on right. Continue straight.
74.6	3.3	Site of old Scott Brook logging camp. Continue straight. DO NOT TURN LEFT.
77.2	2.6	Small Stream. Continue straight.
77.3	0.1	LEFT TURN
78.3	1.0	Outcrops of lithofacies 2 on right.
78.7	0.4	STOP 8. (Location is south of the sketch map.) Outcrop is on the right and in the center of the logging road here, and about 0.1 mile further down the road. Outcrops consist of lithofacies 2. This area is one of the most accessible and prominent areas of this lithofacies. You will have an opportunity to observe sedimentary structures, bedding characteristics and rock types. This concludes the excursion. Return to vehicles and retrace route back to the "main" road.
80.1	1.4	RIGHT TURN
87.3	7.2	Sharp right turn at four road intersection.
101.8	14.5	Great Northern Paper's Ragmuff Gate. LEFT TURN
120.2	18.4	Right turn for those of you who are going the 35 miles to Greenville. Straight for those of you who are going to Millinocket.
128.0	7.8	Pray's Store. End of trip.